APPENDIX A

Finalized Criteria

APPENDIX A: FINALIZED CRITERIA

Introduction

Appendix A contains criteria that have been peer-reviewed and used in one or more projects. These criteria also have an adequate data source that has been 'quality assured/controlled.' The criteria are grouped loosely by topic, although overlap with another group can occur. The descriptions of these groups as well as the general GISST mathematical formula are given in Chapter 3. Published references are italicized, whereas internal documents, letters, or other unpublished references are underlined. Additionally, the score boxes for each criterion reflect a continuous distribution without any gaps among the 1-5 ranking. For example, a criterion that shows 2-4% as rank 1 and 5-7% as rank 2 is calculated without decimal places and thus produces integer ranks only.

Water Quality

D_V Criterion: Surface Water Use	
Supporting Designated Use	Score
≥ 99%	1
98-76%	2
no data	3
75-50%	4
< 50%	5

Databases:

U.S. EPA. 1994. Clean Water Act, Section 305 (b): Oklahoma State Water Quality Inventory Reports, 303 (d) List Region 6, US EPA, Dallas, TX.

National Hydrography Database. http://oaspub.epa.gov/waters/w305b_report.region?p_region=6

National Water Quality Standards Database. http://www.epa.gov/wqsdatabase/index.html

References:

Spooner, C. 1994. *Watershed Agricultural Impact Task Force, W.A.I.T. Report*, Research Triangle Institute (RTI), US EPA, North Carolina.

Definitions, Assumptions, Limitations, Uncertainties:

1. CWA 305(b) reports, with data manipulation, describe the surface water quality for 8 digit HUCs. The NHD also displays such data in the WATERS database.
2. Assessed water bodies are likely to be lower quality segments. Stream segments with no data may or may not be good quality.
3. Designated uses are defined by state water quality programs. The most recent compilation of these is the National Water Quality Standards Database (WQSDB), a single point of access to EPA and state water quality standards (WQS) information.
4. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
5. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Water Quality (STORET Data)

# STORET Exceedances/Area (ft^2)	Score
$< 5.00 \times 10^{-12}$	1
$5.00 \times 10^{-12} \leq$ value $< 5.00 \times 10^{-11}$	2
$5.00 \times 10^{-11} \leq$ value $< 5.00 \times 10^{-10}$	3
$5.00 \times 10^{-10} \leq$ value $< 5.00 \times 10^{-9}$	4
$\geq 5.00 \times 10^{-9}$	5

Databases:

U.S. EPA. 1996. STORET Database, Office of Water, US EPA, Washington, DC.

US EPA Website. Surf Your Watershed/ IWI 1995/6 305(b).http://www.epa.gov/surf/iwi

Definitions, Assumptions, Limitations, Uncertainties:

1. Assessed Safe Drinking Water Act (SDWA) contaminants (22 volatile organic compounds, 35 organics/pesticides, 17 inorganics/metals, and trihalomethane) can adversely impact public health and surface water quality.
2. National primary drinking water standards, established under SDWA, are compared to STORET ambient water data. Comparisons for 65 SDWA contaminants were matched to surface (i.e. stream, lake, reservoir) and ground water (well and springs) STORET data.
3. Exceedances are defined as STORET sampling station data reporting chemical concentration greater than the SDWA MCLs (Maximum Concentration Levels). Sixteen years of data were evaluated.
4. Exceedances are based on 0.5 MCL for IOCs, VOCs, SOCs, RADS, and nitrates for the data years, 1990-1996.
5. Eight digit HUCs were evaluated to determine the scores. The ranking values were the quotients of the number of exceedances in specific HUCs divided by the area in square feet of the associated HUC.
6. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
7. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Rainfall	
Rainfall (in/yr)	Score
< 12.5	1
12.6-25	2
26-37.5	3
37.6-49	4
≥ 50	5

Databases:
Blacklands Research Center, 1995. Humus - Hydrologic Unit Modeling for the United States, USDA/NRCS, USDA/ARS, and Texas A&M University, College Station, TX.

References:
U.S. EPA, 1991. *Regional Assessment of Aquifer Vulnerability and Sensitivity in the Conterminous United States*. EPA/600/2-91/043, Office of Research and Development, Washington, D.C.

Definitions, Assumptions, Limitations, Uncertainties:
1. The greater the annual rainfall, the more infiltration relative to factors such as slope and soil type to the groundwater.

2. The greater the annual rainfall, the more water available for runoff to surface water.

3. All known facilities in a project area receive a comparable amount of annual rainfall.

4. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).

5. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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$D_{v,} D_I$ Criterion: Water Releases	
lbs released to area	Score
≤ 300,000	1
299,999-1,000,000	2
1,000,001-2,000,000	3
2,000,001-5,000,000	4
> 5,000,000	5

Databases:

U. S. Environmental Protection Agency. 2000. Toxic Release Inventory. TRI Data: SARA Community Right-to-know. Washington, D.C. [updated annually]

Steeves, P. and D. Nebert. 1994. Hydrologic Unit Maps of the Conterminous U.S.,U.S. Geological Survey., Reston, VA.

References:

U. S. Environmental Protection Agency. 1989. *Toxic Chemical Release Inventory Risk Screening Guide Volumes 1 and 2*. US EPA Office of Pesticides and Toxic Substances. EPA 560/2-89-002.

Definitions, Assumptions, Limitations, Uncertainties:

1. US EPA requires manufacturing industries to estimate their annual releases of specific hazardous chemicals to water. The releases are reported in pounds per year.
2. Chemical releases to waters within the project area can have a negative impact upon the environment and human health around the release point and downstream.
3. Chemical releases occur over a one year time period and not as a one time event.
4. TRI releases are estimates. There are other data sets which can be used to determine the cumulative chemical release.
5. TRI releases may not represent all the industrial chemical releases to water. Other source data will be included in this criteria (i.e., state and municipal data).
6. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
7. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Surface Water Quantity	
mi /mi^2 shore or stream length	Score
< 0.917	1
0.917-1.15	2
1.16-1.43	3
1.44-1.7	4
> 1.7	5

Databases:

U.S. Census Bureau, 2001. TIGER/Line Files, Census 2000. Washington, D.C.

National Resource conservation Service (NRCS), State Soil Geographic Database (STATSGO), 1/250,000 scale, variable dates for data.

USGS, 1999. National Hydrography Dataset. USGS, Reston, VA.

References:

U.S. Army Corps of Engineers, Section 10 Rivers and Harbors Act of 1899.

U.S. EPA. Clean Water Act, Section 401 and 404, Regulations and Guidance.

Definitions, Assumptions, Limitations, Uncertainties:

1. Surface waters are calculated for segment and shoreline distances for streams, rivers, and lakes. Scaling scores (rankings) are derived from total miles in a watershed or project area divided by the area in square miles of associated HUCs.
2. River and lake surface water areas and depths are not considered.
3. The more surface water area present, the higher potential for ecological impacts.
4. Shoreline is of considerable interest because of the sensitivity of associated ecological communities.
5. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
6. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Distance to Surface Water

Distance (ft)	Score
> 8,100	1
8,100-2,700	2
2,699-900	3
899-301	4
≤ 300	5

Databases:

U.S. Census Bureau, 2001. TIGER/Line Files, RF3 Data. Census 2000. Washington, D.C.

U.S. Geological Survey, 1999. National Hydrography Dataset. Reston, VA.

Definitions, Assumptions, Limitations, Uncertainties:

1. Vulnerable surface waters for this criteria are only those in the U.S. Census Bureau, TIGER 2001 Database.

2. The closest surface water is defined to be the closest surface water down gradient from Federal facility pollution sources.

3. Distance to surface water is measured as straight line distance from the outer boundary of the facility with no buffer zone(incorporation of drainage distances are future enhancements).

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D_V Criterion: Ground Water Probability

Probability[1]	Score
≤ 2.5%	1
2.6- 5%	2
5.1-10%	3
10.1-20%	4
> 20%	5

[1]Probability of ground water being within 6-8 ft. of surface.

Databases:

Oklahoma Water Resources Board. 1993. Statistical Summary of Groundwater Quality Data: 1986-1991 for the Major Groundwater Basins in Oklahoma, FY 93 106 Groundwater Task 400, Planning and Management, Oklahoma City, OK.

National Resource Conservation Service. 1996. Downloadable ten acre grid soils data files from NRCS, Oklahoma City, OK.

National Resource Conservation Service. 1996. Oklahoma STATSGO Database, 1:250,000 soil data. U. S. Department of Agriculture, Washington, D.C.

References:

U.S. EPA. 1987. *Drastic: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings.* EPA/600/2-87/035. Environmental Research Laboratory. Ada, OK.

Definitions, Assumptions, Limitations, Uncertainties:

1. Area of the facility is represented as the facility area plus a ten acre buffer around each site.
2. Only those 10 acres with a >20% probability of ground water being within six to eight feet of the surface(scaling score of 5) were used for the criteria site percentage estimate.
3. The six to eight foot soil profile estimates the probability of ground water vulnerability beneath the facility and buffer area.
4. The higher the probability of ground water beneath the facility the more vulnerable the resource.

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D_V Criterion: Ground Water Quality

Mean Nitrate-Nitrite concentration (mg/L)	Score
no aquifer or < 3	1
3-4.5	2
4.6-6	3
6.1-7.4	4
≥ 7.5	5

Databases:

Oklahoma

Water Resources Board,1993. Statistical Summary of Groundwater Quality Data: 1986-1991 for the Major Groundwater Basins in Oklahoma, FY 93 106 Groundwater Task 400, Planning and Management, Oklahoma City, OK.

National Resource Conservation Service. 1996. Oklahoma STATSGO Database, 1:250,000 soil data. U. S. Department of Agriculture, Washington, D.C.

References:

U.S. EPA. 1991. *Protecting the Nation's Ground Water: EPA's Strategy for the 1990's (part D: Agency Policy on EPA's Use of Quality Standards in Ground Water Prevention and Remediation Activities).* 21Z-1020. Office of the Administrator (WH-550G). Washington, D.C.

Definitions, Assumptions, Limitations, Uncertainties:

1. The Maximum Contaminant Level (MCL) for nitrate in ground water is 10 mg/L established under the Safe Drinking Water Act. Nitrate is assumed to be the major ground water contaminant of concern.
2. Phosphates and other nutrients are not included in this criteria. Nutrients will be covered in separate criteria (i.e. Surface Water Quality)
3. Oklahoma ground water quality data is presented at the county and aquifer level. Approximation of sampling locations were derived from combining aquifer, watershed, river, and county location data.
4. Where counties include more than one aquifer, the watershed or project area that incorporated a certain river was assumed to be associated with the aquifer with the same name as the river.
5. This criterion reflects the acute, non-chronic condition.
6. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
7. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Unified Watershed Assessment (State Priority Data)

Supporting Designated Use	Score
Low State Priority	1
Medium State Priority	3
High Priority or no data	5

Databases:

U.S. EPA. 1994. Clean Water Act, Section 305 (b), State Water Quality Inventory Reports, 303 (d) List. Dallas, TX.

National Hydrography Database. http://oaspub.epa.gov/waters/w305b_report.region?p_region=6

National Water Quality Standards Database. http://www.epa.gov/wqsdatabase/index.html

References:

Spooner, C. 1994. *Watershed Agricultural Impact Task Force, W.A.I.T. Report*, Research Triangle Institute (RTI), US EPA, North Carolina.

Definitions, Assumptions, Limitations, Uncertainties:

1. CWA 305(b) reports, with data manipulation, describe the surface water quality for 8 digit HUCs. The NHD also displays such data in the WATERS database.

2. Assessed water bodies are likely to be lower quality segments. Stream segments with no data may or may not be good quality.

3. Designated uses are defined by state water quality programs. The most recent compilation of these is the National Water Quality Standards Database (WQSDB), a single point of access to EPA and state water quality standards (WQS) information.

4. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).

5. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Clean Water Act 303(d) Segments (State Priority Data)

Present in Grid Cell	Score
No	1
Yes	5

Databases:
TCEQ, 2001. Stream Segments 2000. TCEQ, Austin, TX.

EPA, 2003. Texas Interstate 69 Baseline Analysis Grid. EPA, Region 6, Dallas, TX.

References:
EPA. Clean Water Act 303(d) Regulations & Guidance.

Texas Water Quality standards.

Definitions, Assumptions, Limitations, Uncertainties:
1. CWA 303(d) assessments are done by States and approved by EPA.

2. TMDL= Total Maximum Daily Load.

3. Segments listed as impaired in the file are used in this criteria. Impaired segments receive a score of 5.

4. Stream segments with no data are assumed to be good quality.

5. Designated uses are defined in the State Water Quality Standards.

6. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).

7. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Average Stream Flow

Mean Surface Water Flow (ft^3/sec)	Score
≥ 10,000	1
9,999-1,000	2
999-100	3
99-0.1	4
0 or no data	5

Datasets:
U.S. EPA. 1996. STORET Database, Office of Water, US EPA, Washington, DC.

References:
US EPA Website. Surf Your Watershed/ IWI 1995/6 305(b).http://www.epa.gov/surf/iwi

Definitions, Assumptions, Limitations, Uncertainties:
1. Average cubic feet per second stream flow was calculated over a one year period for existing stream flow monitors operated by States.

2. The less average stream flow the greater the concern for contaminant loading in a water body. This criteria is evaluated with data addressing the potential for pollutants being released to streams in the evaluated watershed or project area.

3. There are significant data gaps. Storet data does not monitor all stream segments in Region 6.

4. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).

5. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V criteria: Sole Source Aquifer (SSA) [1]

SSA is beneath site[2]	Score
No SSA is beneath site	1
SSA is beneath site	5

[1] Sole Source Aquifer (> 50% of drinking water supply to area).
[2] Aquifer or recharge area by data set overlay in GIS.

Databases:
U. S. EPA 1996 Sole source aquifer GIS layer. US EPA Region 6, Dallas, TX

References:
US EPA, 2000. U.S. Environmental Protection Agency Designation of Sole Source Aquifers, Fact Sheet, http://www.epa.gov/earth1r6/ 6wq/swp/ssa/ssafacts.htm, Region 6 Ground Water / UIC Section.

Federal Registers: Edwards Underground Reservoir (40 FR 58344,12/16/75), Chicot Aquifer System (53 FR 20893, 06/07/88), Austin-Area Edwards Aquifer (53 FR 20897, 06/07/88), Southern Hills Aquifer System (53 FR 25538, 07/07/88), Arbuckle-Simpson Aquifer (54 FR 39230, 09/25/89).

Louisiana Geological Survey. 1994. Chicot Aquifer boundaries delineated in part from the Geologic Map of Louisiana Department of Natural Resources.

Mississippi Geological Survey. 1969. Southern Hills boundaries delineated in part from Geologic Map of Mississippi

Slagle, Ardis, and Slade 1986 Edwards Aquifer-Austin Area boundaries delineated from the map Recharge Zone of the Edwards Aquifer Hydrologically Associated with Barton Springs in Austin Area, Texas, 1:48,000.

Definitions, Assumptions, Limitations, Uncertainties:
1. A Sole Source Aquifer is an aquifer designated by EPA as the "sole or principal source" of drinking water for a given service area (supplies 50% or more).
2. There may be many aquifers which could be designated by EPA to be Sole Source Aquifer but are not.
3. Designation are by petition from any person, individual, corporation, State, or Municipality.

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D_V, D_I Criterion: Floodplain	
% of area	Score
No data	0
< 20%	1
20-29%	2
30-39%	3
40-49%	4
≥ 50%	5

Databases:
Federal Emergency Management Agency. Q3 Flood Data (mid-90's data).

References:
Executive Order 11988, 1977. Flood Plain Management.

Definitions, Assumptions, Limitations, Uncertainties:
1. Floodplains are digitized from FEMA FIRMR maps.

2. Percent coverage is quantitative only. No decisions as to floodplain quality were made.

3. Floodplains are defined as the areas where the zone = A (100 year flood plain) or the zone = X500 (500 year flood plain).

4. Changes in upstream hydrology will affect future flooplain extent.

5. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).

6. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Aquifer/Geology Rating

Aquifer Media	Score
No aquifer or massive shale/metamorphic/igneous	1
Weathered/glacial till	2
Sandstone/ limestone	3
Sand/gravel	4
Basalt/karst limestone	5

Databases:

US Geological Survey Digital Data Series DDS-11. Geology of the coterminous United States at 1:2,500,000 scale- a digital representation of King, P. B., and H. M. Beikman map 1974.

US Geological Survey, 1994. Hydrologic unit maps of the coterminous United States.

US EPA, 1987, DRASTIC Typical Ratings, EPA/600/2-87/035.

References:

Allen, E., C. Abshire, M. Bechdol, A. Noell, D. Reazin, J. Torres, and K. Williams, 1997. *Region 6 Interim Source Water Vulnerability Assessment,* Source Water Protection Branch, US EPA, Dallas, TX.

US EPA, 1991. *Regional Assessment of Aquifer Vulnerability and Sensitivity in the Conterminous United States*. EPA/600/2- 91/043.

Definitions, Assumptions, Limitations, Uncertainties:

7. Ratings are a combination of aquifer and geology rankings (Allen et al. 1997), using USGS, EPA DRASTIC, and Aquifer Vulnerability data.
8. The Region 6 methodology (Allen et al.1997) uses an algorithm to combine the aquifer/geology rating and the watershed and aquifer areas (area weighting).
9. Aquifer media ratings are (from lowest to highest rating): massive shale, metamorphic/igneous, weathered, glacial till, bedded sandstone-limestone and shale sequences, massive sandstone, massive limestone, sand and gravel, basalt, karst limestone.

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D_V Criterion: Channelization	
Channels in watershed (mi/mi^2)	Score
0.0	1
0.1-0.515	2
0.5161.400	3
1.401-4.060	4
$\geq$ 4.061	5

Databases:
U.S. Census Bureau, 2001. TIGER/Line Files, Census 2000. Washington, D.C.

References:
Good, W. 1998. Coast 2050: Toward a Sustainable Coastal Louisiana Report, Louisiana Department of Natural Resources, Coast 2050 Planning Management Team. [incomplete citation]

Definitions, Assumptions, Limitations, Uncertainties:
1. Channelization refers to canals, ditches, aqueducts and is not specific to channelization of a specific use or size.
2. Channelization disrupts the natural water flow in an area allowing salt water intrusion and land loss to accelerate.
3. Channelization is a cause of habitat fragmentation.
4. There could be many canals constructed since 1992 which are not captured by the database.
5. There may be canals which are labeled as streams in dataset.
6. Watersheds vary in size, shape, water quantity, and flow characteristics.
7. Boat traffic on canals and runoff into ditches contribute chemical contaminants to the water ecology.
8. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
9. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Individual Well Water [1]

% population with individual water source	Score
< 10	1
10-19	2
20- 29	3
30- 39	4
≥ 40%	5

[1] Source of water to household is not a public system or a private

Databases:
Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:
U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:
1. "Individual" water source is defined as sources other than public or private suppliers.
2. Data is gathered at the block group level and must be modified to apply to watershed or other geographic area.
3. Assessments by watershed or other geographic area use the "area weighting" technique for block groups bisected by geographic boundaries.
4. It is assumed that "individual" water sources are most likely ground water sources accessed and maintained by the resident. In the Region 6 U.S./Mexico Border, and areas of Louisiana (wetlands) and New Mexico (desert) "individual" exist as a variety of sources (i.e., surface, rain collection systems).
5. It is assumed that the "individual" systems are monitored for quality less often, receive anti-microbial treatment sporadically or not at all, be seasonal in quantity and quality, require secondary transport containers, need to be stored without treatment, and therefore more likely to become contaminated.
6. It is assumed that untreated water from "individual" sources will be used for cooking, washing, and cleaning.
7. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
8. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Septic Tank and Cesspool Use [1]

%population with septic tank/cesspool	Score
≤ 15	1
16-25	2
26-35	3
36-45	4
> 45%	5

[1] Wastewater disposal at residence is either a septic tank or cesspool.

Databases:
Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:
U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:
1. Septic tanks are below ground open systems. Cesspools are above ground open waste disposal systems.
2. Data is gathered at the block group level and must be modified to apply to watershed or other geographic area.
3. Assessments by watershed or other geographic area use the "area weighting" technique for block groups bisected by geographic boundaries.
4. It is assumed that other than closed public waste disposal is maintained by the resident. It is also assumed that there are many areas in Region 6 where closed, public waste disposal system are lacking (Border communities (colonias), rural farm sites, mountain, wetland, and desert areas.
5. It is assumed that the septic tank and cesspool have a higher failure rate than public sewage systems, are monitored for quality less often, receive disinfection treatment sporadically or not at all, are seasonal in efficiency, often require periodic cleaning and waste transport, are breeding areas for disease vectors, and are more likely to cause contamination to residents.
6. It is assumed that runoff and percolation to ground water can result in contamination of drinking water sources.
7. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
8. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_I Criterion: TRI[1] Reported Water Releases

lbs released to water	Score
≤ 300,000	1
300,000 < lbs ≤ 1,000,000	2
1,000,000 < lbs ≤ 2,000,000	3
2,000,000 < lbs ≤ 5,000,000	4
> 5,000,000	5

[1] 1998 Toxic Release Inventory Data

Databases:

U. S. Environmental Protection Agency. 2000. Toxic Release Inventory. TRI Data: SARA Community Right-to-know. Washington, D.C. [updated annually]

References:

U. S. Environmental Protection Agency. 1989. *Toxic Chemical Release Inventory Risk Screening Guide Volumes 1 and 2*. US EPA Office of Pesticides and Toxic Substances. EPA 560/2-89-002.

Definitions, Assumptions, Limitations, Uncertainties:

1. US EPA requires manufacturing industries to estimate their annual releases of specific hazardous chemicals to water. The releases are reported in pounds per year.

2. Chemical releases to water can have a negative impact upon the environment and human health around the release point.

3. Chemical releases occur over a one year time period and not as a one time event.

4. TRI releases are estimates.

5. TRI releases may not represent all the industrial chemical releases to water.

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D_V Criterion: Soil Permeability

Rating[1] (in/hr)	Score
< 0.02	1
0.02-0.6	2
0.61-2.0	3
2.01-5.99	4
≥ 6.0	5

[1]Permeability ratings are by 10 acre grids. The average of the grids, inside or touching the facility boundary is ranked 1-5. In addition a site is scored a 5 if the facility area and adjacent buffer is ≥ 6.0 in./hr.

Databases:

National Resource Conservation Service. 1996. Downloadable ten acre grid soils data files from NRCS, Oklahoma City, OK.

National Resource Conservation Service. 1996. Oklahoma STATSGO Database, U. S. Department of Agriculture, Washington, D.C.

References:

U.S. EPA. 1987. *Drastic: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings.* EPA/600/2-87/035. Environmental Research Laboratory. Ada, OK.

Definitions, Assumptions, Limitations, Uncertainties:

1. Area of the facility is represented as the facility area plus a ten acre buffer around each site.

2. Only those 10 acres with a >20% probability of ground water being within six to eight feet of the surface (scaling score of 5) were used for the criteria site percentage estimate.

3. The six to eight foot soil profile estimates the probability of ground water vulnerability beneath the facility and buffer area.

4. The higher the probability of ground water beneath the facility the more vulnerable the resource.

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Ecological

D_V, D_I Criterion: Agricultural Lands

% of Area	Score
< 20%	1
20-39%	2
30-39%	3
40-49%	4
≥ 50%	5

Databases:
U.S. Geological Survey. 2000 National Land Cover Database. Compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters.

Definitions, Assumptions, Limitations, Uncertainties:

1. Agricultural lands are represented by the lands classified as Orchards/Vineyards/Other, Pasture/Hay, Row Crops, Small Grains, and Fallow (NLCD Codes 61 and 81-84).

2. Percent coverage is quantitative only. No decisions as to agricultural land quality were made.

3. A higher percentage of agricultural land cover within an area may indicate a greater potential for concerns under the Prime Farmland Act.

4. For D_I, it is assumed that farmlands are affected if they are located within the project or geographic boundaries.

5. For D_I, the farmlands affected reflect the percentage of wetland area within the project or geographic boundary.

6. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).

7. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V, D_I Criterion: Wetlands

% of Area	Score
< 20%	1
20-39%	2
30-39%	3
40-49%	4
≥ 50%	5

Databases:
U.S. Geological Survey. 2000 National Land Cover Database. Compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters.

Definitions, Assumptions, Limitations, Uncertainties:

1. Wetlands are represented by the lands classified as Woody Wetlands (NLCD code 91) and Emergent Herbaceous Wetlands (NLCD Code 92).

2. Percent coverage is quantitative only. No decisions as to wetland quality were made.

3. The EPA will conduct a separate review with the U.S. Corps of Engineers and/or the U.S. Natural Resources Conservation Service, as necessary, to document compliance with Section 404 of the Clean Water Act.

4. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).

5. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

6. For D_I, it is assumed that wetlands are affected if they are located within the project or geographic boundaries.

7. For D_I, the wetlands affected reflect the percentage of wetland area within the project or geographic boundary.

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D_V, D_I Criterion: Wildlife Habitat	
% of Area	Score
< 20%	1
20-39%	2
30-39%	3
40-49%	4
≥ 50%	5

Databases:
U.S. Geological Survey. 2000 National Land Cover Database. Compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters.

Definitions, Assumptions, Limitations, Uncertainties:
1. Habitats are represented by Forest Lands, Shrublands, Grasslands, Wetlands, and open Water (NLCD Codes 11,41-43, 51, 71, 91-92).

2. Percent coverage is quantitative only. No decisions as to wildlife habitat quality were made.
3. There is no association between this vulnerability score for wildlife habitats and the potential effect, if any, on listed Federal Endangered and Threatened Species, subject to the requirements of the ESA.
4. The EPA will conduct a separate review with the U.S. Corps of Engineers and/or the U.S. Natural Resources Conservation Service, as necessary, to document compliance with Section 404 of the Clean Water Act.
5. For D_I, it is assumed that wildlife habitat is affected if it is located within project or geographic boundaries.
6. For D_I, the wildlife habitat affected reflects the percentage of habitat area within project or geographic boundary.
7. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
8. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Wildlife Habitat Quality (Land Use Data)

Cumulative[1] Land Use Ranking	Score
≤ 1	1
1.1-2	2
2.1 -3	3
3.1-4	4
> 4	5

[1] Each land use is judged as to wildlife habitat quality (1-5 scale with 5 the highest value). The percent of the habitat in the watershed is multiplied times the rank value. Values are summed. Five is the highest value possible.

Databases:

U.S. Geological Survey. 2000 National Land Cover Database. Compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters.

References:

Anderson, J. 1978. *A Land Use and Land Cover Classification System for Use with Remote Sensor Data*, Department of the Interior.

Definitions, Assumptions, Limitations, Uncertainties:

1. Wildlife Habitats are given a rank score of 5 and are represented by wetlands, rangelands, forest lands, woodlands, open water, shrubland, herbaceous uplands.
2. A 1 to 5 scaled ranking of habitats based on land use descriptors (NRCS, 1995 Landuse Data set) were determined. The ranking are: 1 = industrialized/transportation/ commercial areas; 2 = high intensity residential; 3 = low intensity residential, urban recreational grasses, bare rocks, sand, and clay, transitional areas; 4 = agricultural; 5 = wildlife habitat defined as rangeland, wetlands, forest lands, woodlands, herbaceous uplands, shrublands, open water. The higher the rank, the more valued the habitat. The greater the area for each, the more weighting (e.g., if 10% of area is a 3 ranking and 90 % is a 5 ranking, then the weighting is calculated: [0.1 X 3 + 0.9 X 5] = [0.3 + 4.5] = 4.8 becomes the area weighted ranking. The higher the value score the more concern. Percent coverage is quantitative only. No decisions as to wildlife habitat quality were made. No association to listed Federal Endangered and Threatened Species, subject to the requirements of the ESA.

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D_V Criterion: Habitat Fragmentation

PAR	Score
0-0.1	1
0.2-0.3	2
0.4-0.5	3
0.6-0.8	4
0.9-1	5

Databases:

U.S. Geological Survey. 2000 National Land Cover Database. Compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters.

References:

White, M. et al. 2002. Draft Landscape Atlas of Ecosystem Health in EPA Region 5. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Perimeter to area ratio (PAR) is one measure of habitat fragmentation and landscape pattern.
2. A perfect circle has the shortest perimeter to area, making it the most idealized condition.
3. Area to perimeter is used here to identify the less fragmented geographic areas as an indicator of landscapes to be protected. Perimeter to area calculations are used in linear project analyses to facilitate comparisons between alternative routes.
4. The perimeter-to-area ratio has the formula: $[P/(A_{ideal)} / P/(A_{real})] = [(2 * pi * (a_{real}/pi)^{0.5}/areal) / (preal/a_{real})]$.
5. The PAR calculated here is a relative measure and calculates how closely a real landscape matches with the ideal (a perfect circle). Unity equals a perfect circle and a value of zero equals a patch that is long and narrow (i.e., very different from the ideal condition).
6. The results of the calculation of PAR may be normalized using log base 10.
7. The habitat fragmentation criteria is associated with the percent habitat in the watershed, wildlife and non-wildlife areas, habitat value, and anthropological activities.
8. Habitat fragmentation may cause aquatic habitat changes, animal range disruption, disruption of natural barriers, migration routes, dispersal patterns for plants, channelization, impacts of oil leaks, noise, diesel and gasoline engine emissions.
9. Wildlife habitats include open water, flood plains, wetlands, bottomland hardwoods, rangelands, upland forests and grasslands.
10. The creation of "edge" terrestrial habitats from human activities is recognized but not accounted for.

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D_I Criterion: Federally Listed Endangered and Threatened Species

Present in area	Score
No	1
Yes	5

Databases:

TPWD, 2002. Biological Conservation Database (points). TPWD, Austin, TX.

EPA, 2003. Texas Interstate 69 Baseline Analysis Grid. EPA, Region 6, Dallas, TX.

References:

U.S. Department of Interior. 1973. Endangered Species Act. US Fish and Wildlife Service, Washington DC (as amended).

U. S. EPA. 1970. "Implementation Regulations for the National Environmental Policy Act", Washington, DC.

Definitions, Assumptions, Limitations, Uncertainties:

1. Those elemental occurrences of species that have a federal status of Endangered or Threatened.

2. Areas subject to the requirements of the Endangered Species Act . Consultation with U.S. FWS is indicated.

3. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).

4. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_I Criterion: State Listed Endangered and Threatened Species

Present in area	Score
No	1
Yes	5

Databases:

TPWD, 2002. Biological Conservation Database (points). TPWD, Austin, TX.

EPA, 2003. Texas Interstate 69 Baseline Analysis Grid. EPA, Region 6, Dallas, TX.

Definitions, Assumptions, Limitations, Uncertainties:

1. Those elemental occurrences of species that have a State status of Endangered or Threatened.

2. Areas subject to the requirements state requirements protecting endangered and threatened species. Consultation with the State wildlife department is indicated.

3. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).

4. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_I Criterion: Endangered Species Act Compliance

Section 7 Compliance[1]	Score
Yes	1
No	5

[1]Section 7 of Endangered Species Act of 1977

Databases:
Information supplied by facility.

References:
U.S. Department of Interior. 1977. *Endangered Species Act*. US Fish and Wildlife Service, Washington DC.

U. S. EPA. 1970. Implementation Regulations for the National Environmental Policy Act, Washington, DC. [incomplete citation]

Definitions, Assumptions, Limitations, Uncertainties:
1. Federal non-compliance constitutes potential significant adverse impacts on listed endangered and threatened species.

2. Section 7 decision based on consultation with and advice of the US Fish and Wildlife Service.

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D_V Criterion: Ecologically Significant Stream Segments

Presence in area	Score
No	1
Yes	5

Databases:

TPWD, 2000-2001. Ecologically Significant Stream Segments, TPWD, Austin, TX.

EPA, 2003. Texas Interstate 69 Baseline Analysis Grid. EPA, Region 6, Dallas, TX.

Definitions, Assumptions, Limitations, Uncertainties:

1. In accordance with the TWDB's rules, the following criteria are to be used when recommending a river or stream segment as being of unique ecological value:
   - Biological Function: Segments which display significant overall habitat value including both quantity and quality considering the degree of biodiversity, age, and uniqueness observed and including terrestrial, wetland, aquatic, or estuarine habitats;
   - Hydrologic Function: Segments which are fringed by habitats that perform valuable hydrologic functions relating to water quality, flood attenuation, flow stabilization, or groundwater recharge and discharge;
   - Riparian Conservation Areas: Segments which are fringed by significant areas in public ownership including state and federal refuges, wildlife management areas, preserves, parks, mitigation areas, or other areas held by governmental organizations for conservation purposes under a governmentally approved conservation plan;
   - High Water Quality/Exceptional Aquatic Life/High Aesthetic Value: Segments and spring resources that are significant due to unique or critical habitats and exceptional aquatic life uses dependent on or associated with high water quality;
   - Threatened or Endangered Species/Unique Communities: Sites along segments where water development projects would have significant detrimental effects on state or federally listed threatened and endangered species, and sites along segments that are significant due to the presence of unique, exemplary, or unusually extensive natural communities.

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DRAFT D_V Criterion: TEAP Diversity

Percent in $1km^2$	Score
lowest 51-100%	1
26-50%	2
11-25%	3
2-10%	4
top 1% most diverse polygons	5

Databases:

USGS. 2000. Texas National Land Cover Data Set (circa 1992), http://landcover.usgs.gov/natllandcover.asp.

TPWD. 1995. Ecological Stream Segments of Concern

Fire Sciences Laboratory, Rocky Mountain Research Station, 2001, Kuchler's Potential Natural Vegetation Groups, Version 2000, Missoula, MT.

References:

Osowski, S. L., J. E. Danielson, S. Schwelling, D. German, S. Gilbert, D. Lueckenhoff, D. Parrish, A. K. Ludekeand J. Bergan. 2004. Texas Environmental Resource Stewards (TERS) Texas Ecological Assessment Protocol (TEAP) Results, Pilot Project Report. Report Number EPA-906-C-05-001. US Environmental Protection Agency Region 6, Dallas, TX.

Küchler, A. W. 1975. Potential natural vegetation of the conterminous United States. 2d ed. Map 1:3,168,000. American Geographical Society.

Definitions, Assumptions, Limitations, Uncertainties:

1. Because the TEAP was calculated using a $1km^2$ grid developed by Texas Parks and Wildlife Department, the scores for this criteria may be up to 0.5 km^2 off from the original $1km^2$ grid developed by EPA Region 6 for the GISST calculation for IH69.
2. The diversity layer consists of four sub-layers: appropriateness of land cover, contiguous size of undeveloped area, Shannon land cover diversity, and ecologically significant stream segments.
3. The overall diversity layer was calculated by taking the mean of the four diversity sub-layers and rescaling on a 0-100 scale. Higher scores indicate a higher level of diversity. The values of the 30 m pixels that made up each 1 km^2 (one kilometer square) grid cell were averaged to determine the Diversity Index score for each cell.
4. A US EPA program, ATTiLA was used to calculate Shannon land cover diversity.
5. Further details on TEAP calculations can be found in the TEAP Results Report.

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DRAFT D_V Criterion: TEAP Rarity

Percent in $1km^2$	Score
lowest 51-100%	1
26-50%	2
11-25%	3
2-10%	4
top 1% rarity	5

Databases:

USGS, 2000, Texas National Land Cover Data Set, http://landcover.usgs.gov/natllandcover.asp.
TPWD TXBCD & Natural Heritage data

References:

Osowski, S. L., J. E. Danielson, S. Schwelling, D. German, S. Gilbert, D. Lueckenhoff, D. Parrish, A. K. Ludekeand J. Bergan. 2004. Texas Environmental Resource Stewards (TERS) Texas Ecological Assessment Protocol (TEAP) Results, Pilot Project Report. Report Number EPA-906-C-05-001. US Environmental Protection Agency Region 6, Dallas, TX.

Definitions, Assumptions, Limitations, Uncertainties:

1. Because the TEAP was calculated using a $1km^2$ grid developed by Texas Parks and Wildlife Department, the scores for this criteria may be up to 0.5 km^2 off from the original $1km^2$ grid developed by EPA Region 6 for the GISST calculation for IH69.
2. The rarity layer consists of four sub-layers: vegetation rarity, natural heritage rank, taxonomic richness, and rare species richness.
3. The overall rarity layer was calculated by taking the mean of the four Rarity layer sub-layers and rescaling on a 0-100 scale. Higher scores indicate a higher level of rarity. The values of the 30 m pixels that made up each 1 km^2 grid cell were averaged to determine the Rarity Index score for each cell. Overall rarity was calculated by recoding rarity ranks using an exponential growth function 0-250 to produce a statewide land cover rarity data set. Data were scaled 0-250, due to machine processing of 8-bit data. Because the input data sets for Texas were large, rescaling the data from 1-250 (8-bit) allowed for much faster machine processing without any significant loss of granularity. Exponential scaling was chosen to give appropriate weight to rarer features. The statewide land cover rarity data set and the land cover rarity by ecoregion data set were input into an averaging model to compute the mean value of each grid cell for the combined data sets.
4. Further details on TEAP calculations can be found in the TEAP Results Report.

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DRAFT D_V Criterion: TEAP Sustainability

Percent in $1km^2$	Score
lowest 51-100%	1
26-50%	2
11-25%	3
2-10%	4
top 1% most sustainable polygons	5

Databases:

USGS, 2000, Texas National Land Cover Data Set, http://landcover.usgs.gov/natllandcover.asp.
Fire Sciences Laboratory, Rocky Mountain Research Station, 2001, Kuchler's Potential Natural Vegetation Groups, Version 2000, Missoula, MT.
U.S. Bureau of the Census, 2000, TIGER/Line Files. Census Bureau, Washington, D.C.
U.S. EPA, 2003, National Priority List Database. EPA Region 6, Dallas, TX.
TCEQ, 2003, State Superfund Sites. Austin, TX.
U.S. EPA, 2003, RCRA TSD database. EPA Region 6, Dallas, TX.
U.S. EPA, 2003, Corrective Action database. EPA Region 6, Dallas, TX.
TCEQ, 2003, Voluntary Cleanup Program database. TCEQ, Austin, TX.
Bureau of Transporation Statistics, 2002, U.S. Airport Database. BTS, Washington, D.C.
U.S. EPA, 2003, Ozone Nonattainment Areas. EPA Region 6, Dallas, TX
TCEQ, 2003, State Near Nonattainment Areas. TCEQ, Austin, TX.
TCEQ, 2002, Dam Dataset. TCEQ, Austin, TX.
TCEQ, 2000, 303d Stream Segments of Concern. TCEQ, Austin, TX.

References:

Osowski, S. L., J. E. Danielson, S. Schwelling, D. German, S. Gilbert, D. Lueckenhoff, D. Parrish, A. K. Ludekeand J. Bergan. 2004. Texas Environmental Resource Stewards (TERS) Texas Ecological Assessment Protocol (TEAP) Results, Pilot Project Report. Report Number EPA-906-C-05-001. US Environmental Protection Agency Region 6, Dallas, TX.

Definitions, Assumptions, Limitations, Uncertainties:

1. The sustainability layer describes the state of the environment in terms of stability, that is, how resistant to disturbance an area is, and how capable is the area in returning to its pre-disturbance state, that is, resilience (Begon et al. 1986). Sustainable areas are those that can maintain themselves into the future without human management.
2. Because the TEAP was calculated using a $1km^2$ grid developed by Texas Parks and Wildlife Department, the scores for this criteria may be up to 0.5 km^2 off from the original $1km^2$ grid developed by EPA Region 6 for the GISST calculation for IH69.
3. The sustainability layer consists of eleven measures that can be loosely grouped into fragmentors: contiguous land cover type, regularity of ecosystem boundary,

appropriateness of land cover, waterway obstruction, road density and stressors: airport noise, Superfund National Priority List and State Superfund Sites, water quality, air quality, RCRA, Treatment-Storage-Disposal sites, Corrective Action and State Voluntary Cleanup Program Sites, and urban/agricultural disturbance.

4. The overall sustainability layer was calculated by taking the mean of the eleven sub-layers and rescaling on a 0-100 scale. Higher scores indicate a higher level of sustainability. The values of the 30 m pixels that made up each 1 km^2 (one kilometer square) grid cell were averaged to determine the Sustainability Index score for each cell.
5. Further details on TEAP calculations can be found in the TEAP Results Draft Report.

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DRAFT D_V Criterion: TEAP Composite/Ecological Importance

Percent in $1km^2$	Score
lowest ecological importance (lowest 51-100% of scores)	1
26-50%	2
11-25%	3
2-10%	4
top 1% most ecologically important location	5

Databases:
Diversity, Rarity, and Sustainability Data created in TEAP

References:
Osowski, S. L., J. E. Danielson, S. Schwelling, D. German, S. Gilbert, D. Lueckenhoff, D. Parrish, A. K. Ludekeand J. Bergan. 2004. Texas Environmental Resource Stewards (TERS) Texas Ecological Assessment Protocol (TEAP) Results, Pilot Project Report. Report Number EPA-906-C-05-001. US Environmental Protection Agency Region 6, Dallas, TX.

Definitions, Assumptions, Limitations, Uncertainties:
1. The composite layer is composed of the three main layers: Diversity, Rarity, and Sustainability calculated for TEAP.

2. Because the TEAP was calculated using a $1km^2$ grid developed by Texas Parks and Wildlife Department, the scores for this criteria may be up to 0.5 km^2 off from the original $1km^2$ grid developed by EPA Region 6 for the GISST calculation for IH69.

3. The composite layer was calculated by taking the sum of the three main layers and rescaling on a 0-300 scale. Higher scores indicate a higher level of ecological importance. The values of the 30 m pixels that made up each 1 km^2 (one kilometer square) grid cell were averaged to determine the score for each cell.

4. Further details on TEAP calculations can be found in the TEAP Results Draft Report.

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D_V Criterion: Road Density	
Road density (mi/mi^2)	Score
< 1.2	1
1.2-1.8	2
1.9-2.2	3
2.3-2.5	4
≥ 2.6 mi./sq.mi. watershed	5

Databases:

U.S. Census Bureau, 2001. TIGER/Line Files, Census 2000. Washington, D.C.

U.S. Geological Surey, 2000, National Hydrography Dataset, Reston, VA.

Definitions, Assumptions, Limitations, Uncertainties:

5. There can be many more roads in a defined geographic area than those documented in the 1992 Census information.
6. An increased relative number of roads in a defined geographic area and associated traffic is an indicator of air, land, and water pollution (inorganics and hydrocarbons), human health, ecological, and economic concerns to include (noise, urbanization, industrialization, increased probability of traffic accidents, habitat fragmentation, ecological stress, wetland destruction).
7. Traffic capacity for roads are not considered. A residential street and a paved rural road have approximately the same methodology weighting as a six lane freeway. This limitation has more impact in rural areas (may have a relatively short but very busy highway through the watershed).
8. All roads in TIGER are equal in significance (two lane, four lane, rural, urban).
9. Number of bridges, overpasses, road grade, terrain, or landuse information is not considered in this criteria.
10. All roads contribute to restricted wildlife movement, habitat fragmentation, nutrient loading and increased stream sedimentation, and unnatural water runoff (contaminated and non contaminated waters).
11. The "defined geographic area" can be watershed subunits, transportation corridors, project areas, etc.
12. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_v Criterion: Watershed/Geographic Area [1]

Watershed or Geographic Area	Score
< 5% of the geographic area is occupied by facilities	1
5-9%	2
10-14	3
≥ 15%	4

[1] $[\Sigma A_I / A_{WS}]$ is the ratio of the cumulative area occupied by the facility (ΣA_I) to the area of the watershed or geographic area (A_{WS}). Multiplied by 100 is the percent of the geographic area impacted.

Databases:

Facility

boundary data submitted by facility (received upon request or taken from EPA RCRA, NPDES, NEPA, or other regulatory files).

Steeves, P. and D. Nebert. 1994. Hydrologic Unit Maps of the Conterminous U.S.,U.S. Geological Survey., Reston, VA.

References:

U.S. EPA. 1992. *A Synoptic Approach to Cumulative Impact Assessment: A Proposed Methodology*. EPA/600/R-92/167. Office of Research and Development. U. S. Environmental Protection Agency. Washington, D.C.

US EPA Website. Surf Your Watershed/ IWI 1995/6 305(b).http://www.epa.gov/surf/iwi

Definitions, Assumptions, Limitations, Uncertainties:

1. One square mile = 27,878,400 sq.ft.

2. The potential for negative environmental impact increases as the percentage of watershed subunits (HUC) or other geographic area occupied by facilities increases.

3. Potential cumulative impacts can be measured by assessing the additive activities of regulated and non regulated industries. These activities include amount of land and water occupied by these industries. Facilities include, defense facilities, agriculture operations, municipal works, private industry, state and local government operations.

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D_I Criterion: Density of Managed Lands

Presence in project area	Score
No	1
Yes	5

Databases:
EPA, 2003. Consolidated Managed Land for Texas. EPA, Region 6, Dallas, TX.

Definitions, Assumptions, Limitations, Uncertainties:
1. Managed lands include National Park Service Lands, National Forest Service Lands, U.S. Fish & Wildlife Service Lands, State Parks and Wildlife Areas, City Parks, County Parks, and other lands used for conservation/recreation. Managed lands also may include other large properties owned/managed by the Federal Government such as Military Bases, BLM Lands, and DOE Lands.
2. The more managed lands in a project area, the greater the potential for negative impacts.
3. Five mile radius is used to be comparable with other Region 6 risk index analyses (e.g. Human Health Risk Index, Environmental Justice Index).
4. The majority of managed lands are assumed to be in the same watershed, but there is the possibility that managed lands can be in different HUCs.
5. Locations of managed lands may be used to avoid or minimize impacts, as well as for resource enhancement and compensation issues.
6. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
7. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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Air Quality

D_V Criterion: Air Quality

Distance from nonattainment area[1]	Score
> 10 miles	1
6 - 10 miles	2
2 - 5 miles	3
≤ 2 miles	4
0 miles	5

[1] For any of the criteria air pollutants: ozone, lead, particulates, CO, SOx, NOx.

Databases:
U. S. EPA. 2003. Ozone nonattainment GIS layer created from Ozone Nonattainment Greenbook.

References:
CFR Part 81 Clean Air Act.

U. S. EPA. Ozone Nonattainment Greenbook. www.epa.gov/oar/oaqps/greenbk

Definitions, Assumptions, Limitations, Uncertainties:
1. For any of the criteria air pollutants; ozone, lead, particulates, CO, SO_x, NO_x.

2. Air nonattainment areas were used to calculate this score.

3. Not stratified by pollutant since lead, CO, and SO_x, are not high concerns in Region 6.

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D_V Criterion: Ozone Nonattainment

Project Location	Score
outside nonattinment area	1
near nonattainment area	3
inside nonattainment area	5

Databases:
Census, 2001. TIGER Counties. Coverage by EPA, Region 6, Dallas, TX.

TCEQ, 1998. Nonattainment Areas. TCEQ, Austin, TX.

References:
CFR Part 81 Clean Air Act. Http://www.epa.gov/airs/nonattn.html

U.S. EPA, 2002. Green Book – Nonattainment Areas for Criteria Pollutants. www.epa.gov/oar/oaqps/greenbk

Definitions, Assumptions, Limitations, Uncertainties:
1. Nonattainment Areas (from EPA Green Book)-These are designations of 1 hour ozone nonattainment areas. It reflects the current status of 1-hour nonattainment areas and does not reflect the 8-hour standard. EPA has not yet designated areas for the 8-hour standard.

2. Near Nonattainment Areas (from TCEQ metadata)-Near nonattainment means an area is very close to falling into non compliance with the NAAQS. These counties have been designated by the TCEQ Office of Policy and Regulatory Development for planning reasons. These counties either have an ozone monitor or are part of a MSA that has an ozone monitor. It is very uncertain at this point which near nonattainment counties, if any, will ultimately be designated by the EPA as nonattainment.

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D_I Criterion: TRI[1] Reported Air Releases[2]

lbs released to air	Score
≤ 300,000	1
299,999- 1,000,000	2
1,000,001-2,000,000	3
2,000,001-5,000,000	4
> 5,000,000	5

[1] 2000 Toxic Release Inventory Data

[2] Fugitive and stack emissions (annual estimate data)

Databases:

U. S. Environmental Protection Agency. 2000. Toxic Release Inventory. TRI Data: SARA Community Right-to-know. Washington, D.C. [updated annually]

References:

U. S. Environmental Protection Agency. 1989. *Toxic Chemical Release Inventory Risk Screening Guide Volumes 1 and 2*. US EPA Office of Pesticides and Toxic Substances. EPA 560/2-89-002.

Definitions, Assumptions, Limitations, Uncertainties:

3. Information supplied by facility. US EPA requires manufacturing industries to estimate their annual releases of specific hazardous chemicals to air. The releases are reported in pounds per year.
4. Air releases are from stack and fugitive emissions.
5. Chemical releases to air can have a negative impact upon the environment and human health around the release point.
6. Chemical releases occur over a one year time period and not as a one time event.
7. TRI releases are estimates.
8. TRI releases may not represent all the industrial chemical releases to air.
9. TRI has added new chemicals over the years and the industries included may have changed.

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Socioeconomic

D_V Criterion: Colonias [1]

Total Number of Colonias/county	Score
0	1
≤ 25	2
26-50	3
51-125	4
> 125	5

[1] (Texas and New Mexico only)

Databases:

Colonias dataset, NM made from New Mexico State University, TX made from Texas Water Development Board.

References:

U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Colonias are typically unincorporated residential areas where municipal services are lacking (garbage disposal, sewage disposal, drinking water plumbing to home.
2. Texas Water Development Board defined colonias are locations in the Economically Distressed Area Program.
3. These data are point locations which are applied to county, watershed, or other boundary.
4. Data is used for Texas and New Mexico at this time. Other Region 6 states have areas which would meet the Texas or New Mexico "colonias" definition (other than location along the U.S./Border).
5. It is assumed that colonia unincorporated communities have self maintained and dug well systems, surface or other source of water for drinking, cooking, bathing, and cleaning. It is also assumed that septic tanks, cesspools, or other sewage disposal system is used as well as other than public means of garbage disposal.
6. It is assumed that wells and surface water are more easily contaminated than public systems, that septic tank and cesspools have a higher failure rate than public sewage systems, and with individual resident garbage locations are breeding areas for disease vectors.
7. Colonias by definition are residential areas. The lack of public services in these populated areas increases the chance of environmental contamination and resulting disease.

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D_V Criterion: High School Education

% population without High School Diploma	Score
≤ the State average	1
State avg-1.33 x State avg	2
1.34 x State avg-1.66 x State avg	3
1.67 x State avg-2 x State avg	4
> 2 x State avg	5

Databases:

Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Education data is captured by block group in the census.
2. Assessments by watershed or other geographic area use the "area weighting" technique for block groups bisected by geographic boundaries.
3. It is assumed that the higher the education level of a population the better prepared that community is for environmental understanding, danger avoidance, and responsible actions leading to environmental protection.
4. It is assumed that the higher the education level the more able a population is to protect its members from harmful exposures and to discover and articulate community concerns.
5. It is assumed that watershed boundaries are as appropriate or better than other boundaries (county lines, city limits) to evaluate environmentally based issues.
6. The education criteria should not be used alone but should be considered with other socioeconomic criteria (income, age, population density, language barriers).
7. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
8. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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D_V Criterion: Educational Achievement Ranking

Cumulative Score for Education Achievement[1]	Score
College Degree	1
Some College (No Degree)	2
High School Degree (or GED)	3
9^{th} to 12^{th} Grade (No Degree)	4
< 9^{th} Grade	5

Databases:
Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:
U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:
1. Education data is captured by block group in the census.
2. The educational attainment score is calculated by multiplying a weighted factor for each educational level by the percentage of persons at that level, then summing the level scores to arrive at a single score of 1 through 5. [{(% with College Degree) / 100} * 1] + [{(% Some College) / 100} * 2] + [{(% High School Degree) / 100} * 3] + [{(% 9-12 grade) / 100} * 4] +[{(% < 9 grade) / 100} * 5].
3. Assessments by watershed or other geographic area use the "area weighting" technique for block groups bisected by geographic boundaries.
4. It is assumed that the higher the education level of a population the better prepared that community is for environmental understanding, danger avoidance, and responsible actions leading to environmental protection.
5. It is assumed that the higher the education level the more able a population is to protect its members from harmful exposures and to discover and articulate community concerns.
6. It is assumed that geographic boundaries are as appropriate or better than other boundaries (county lines, city limits) to evaluate environmentally based issues.
7. The education criteria should not be used alone but should be considered with other socioeconomic criteria (income, age, population density, language barriers).

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D_V Criterion: Economic (Environmental Justice)

% Economically stressed	Score
≤ State avg	1
State avg-1.33 x State avg	2
1.34 x State avg-1.66x State avg	3
1.67 x State avg-1.99 times the State avg	4
≥ 2 x State avg	5

Databases:
Census 2000
Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:
Lavelle, M., and M. Coyle. 1992. Unequal Protection: The Racial Divide in Environmental Law. *National Law Journal* 15:2-12.

U.S. EPA. 1992. *Environmental Equity: Reducing Risk for All Communities*. EPA230-R-92-008. Office of Policy, Planning, and Evaluation (PM-221), U. S. Environmental Protection Agency, Washington, D.C.

U.S. EPA. 1995. Computer Assisted Environmental Justice Index Methodology. Office of Planning and Analysis, Enforcement Division, Region 6 EPA, Dallas, TX.[unpublished]

U.S. EPA. 1994. *Executive Order 12898:Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.* 59 Federal Register Notice 7629 (1994).

Definitions, Assumptions, Limitations, Uncertainties:
1. Demographic data will be 2000 SF3 Census coverage.
2. The economic analysis calculated for a four mile radius (minimum 50 square miles) from the boundary of the facility.
3. It is assumed that there are different social-economic factors specific to each Region 6 state which justifies using state averages for comparisons. Factors include: availability of insurance and health care benefits for residents, education opportunities, public transportation systems, infrastructure stress related to language differences, state income tax, ethnic differences, employment rate and stability of industrial - business base, housing and utility costs, use of land, presence of rural and urban areas, availability of natural resources.
4. Economically stressed households are those that earn an income of ≤ $15,000 for the 1990 Census and ≤ $20,000 for the 2000 Census.

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D_V Criterion: Minority (Environmental Justice)

% minority	Score
≤ State avg	1
State avg-1.33 x State avg	2
1.34 x State avg-1.66 x State avg	3
1.67 x State avg-1.99 x the State avg	4
≥ 2 x State avg	5

Databases:

Census 2000

Redistricting Data (Public Law 94-171) Summary File – (AR, LA, NM, OK, TX) [machine-readable data files] / prepared by the U.S. Census Bureau, 2001.

References:

U.S. EPA. 1995. Computer Assisted Environmental Justice Index Methodology. Office of Planning and Analysis, Enforcement Division, Region 6 EPA, Dallas, TX. [unpublished]

U.S. EPA. 1994. Executive Order 12898: "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations". 59 Federal Register Notice 7629 (1994).

U.S. EPA. 1992. *Environmental Equity: Reducing Risk for All Communities*. Office of Policy, Planning, and Evaluation (PM-221), EPA230-R-92-008, Washington, D.C.

Lavelle, M., and M. Coyle. 1992. Unequal Protection: The Racial Divide in Environmental Law. *National Law Journal* 15:2-12.

Definitions, Assumptions, Limitations, Uncertainties:

1. Demographic data will be 2000 PL94-171 Census coverage.
2. The minority analysis calculated for a four mile radius (minimum 50 square miles) from the boundary of the facility.
3. It is assumed that there are different social-economic factors specific to each Region 6 state which justifies using state averages for comparisons. Factors include: availability of insurance and health care benefits for residents, education opportunities, public transportation systems, infrastructure stress related to language differences, state income tax, ethnic differences, employment rate and stability of industrial - business base, housing and utility costs, use of land, presence of rural and urban areas, availability of natural resources.
4. In New Mexico, the minority population makes up the majority of the residents in that state. Therefore, a score of “5" is statistically not possible.

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D_V Criterion: Age [1] (7 > Age ≥ 55 Years old)

% 7 > age >55 yrs old	Score
≤ State average	1
State average-1.33 x State avg	2
1.34 x State avg-1.66 x State avg	3
1.67 x State avg-2 x State avg	4
> 2 x State avg	5

[1] Vulnerable ages are assumed to be < 7 y/o and > 55 y/o.

Databases:

Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

U.S. EPA. 1995. Computer Assisted Environmental Justice Index Methodology. Office of Planning and Analysis, Enforcement Division, Region 6 EPA, Dallas, TX.[unpublished]

U.S. EPA. March 1999. Region 6 Program Plan for Protecting Children from Environmental Health Risks and President Clinton's Executive Order 13045, April 21. 1997, to Protect Children from Environmental Health Risks and Safety Risks. [unpublished]

Bearer, Cynthia F. September 1995. "Environmental Health Hazards: How Children are Different From Adults", in Environmental Health Perspectives, Vol. 103, Supplement 6. [incomplete citation]

Goldman, Lynn R. and Sudha Koduru. June 2000. "Chemicals in the Environment and Developmental Toxicity to Children: A Public Health and Policy Perspective" in Environmental Health Perspectives, Vol. 108, Supplement 3.[incomplete citation]

Definitions, Assumptions, Limitations, Uncertainties:

1. The definition of children being (< 7 years old) is partly based upon organ development, education, and physical size considerations.
2. Age 55 representing "older" individuals is partly based upon organ reserve, physical ability, cumulative health risk considerations (i.e., consequences of smoking, diet, life style, occupational exposures,and other factors).
3. Demographic data will be 2000 SF3 Census coverage, changing to year 2000 data the summer of 2001.
4. The "Age" analysis is a comparison to the state average and can be calculated for many different areas (block groups, tracts, counties, of radii around a point location). Region 6 EPA enforcement, education and health risk targeting demographic evaluations (i.e., age, income, ethnicity, education) are often for 0.56 and 4 mile radii.
5. Children and older individuals are more susceptible to environmental health risks.
6. Children and the older population are not susceptible to the same environmental pollutants or conditions (i.e., ultra-violet light, carbon monoxide) or have the same

reactions to environmental stressors (i.e., asthma, cardio-respiratory disease).

7. It is assumed that there are different social-economic factors specific to each Region 6 state which justifies using state averages for comparisons. Factors include: availability of insurance and health care benefits for residents, education opportunities, public transportation systems, infrastructure stress related to language differences, state income tax, ethnic differences, employment rate and stability of industrial - business base, housing and utility costs, use of land, presence of rural and urban areas, availability of natural resources.

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D_V Criterion: Children [1] (population < 7 Years old)

%< 7 yrs old	Score
≤ State average	1
State average-1.33 x State avg	2
1.34 x State avg-1.66 x State avg	3
1.67 x State avg- 2 x State avg	4
> 2 x State avg	5

[1] Vulnerable age for children is assumed to be < 7 y/o

Databases:

Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

U.S. EPA. 1995. Computer Assisted Environmental Justice Index Methodology. Office of Planning and Analysis, Enforcement Division, Region 6 EPA, Dallas, TX.[unpublished]

U.S. EPA. March 1999. Region 6 Program Plan for Protecting Children from Environmental Health Risks and President Clinton's Executive Order 13045, April 21. 1997, to Protect Children from Environmental Health Risks and Safety Risks. [unpublished]

Bearer, Cynthia F. September 1995. "Environmental Health Hazards: How Children are Different From Adults", in Environmental Health Perspectives, Vol. 103, Supplement 6. [incomplete citation]

Goldman, Lynn R. and Sudha Koduru. June 2000. "Chemicals in the Environment and Developmental Toxicity to Children: A Public Health and Policy Perspective" in Environmental Health Perspectives, Vol. 108, Supplement 3. [incomplete citation]

Vaughan, V., editor. 1975. *Nelson Textbook of Pediatrics*, 10th edition. W.B. Saunders Company, Philadelphia, PA.

Definitions, Assumptions, Limitations, Uncertainties:

1. The definition of children being (< 7 years old) is partly based upon organ development, education, and physical size considerations.
2. Demographic data will be 2000 SF3 Census coverage, changing to year 2000 data the summer of 2001.
3. The "Age" analysis is a comparison to the state average and can be calculated for many different areas (block groups, tracts, counties, of radii around a point location). Region 6 EPA enforcement, education and health risk targeting demographic evaluations (i.e., age, income, ethnicity, education) are often for 0.56 and 4 mile radii.
4. Children and older individuals are more susceptible to environmental health risks.
5. Children are susceptible to all environmental pollutants or conditions (i.e., ultra-violet light, lead, second hand smoke, pesticides, industrial air emissions) often with age

specific disorders (i.e., asthma, neurological impairment, immune and hormone system disorder, leukemia and other childhood cancers). For these reasons it is important to know where high number of children populations may be in Region 6 EPA and to correlate this information with chemical release data and socio-economic factors (i.e., language, education, poverty, ethnicity).

6. It is assumed that there are different social-economic factors specific to each Region 6 state which justifies using state averages for comparisons. Factors include: availability of insurance and health care benefits for residents, education opportunities, public transportation systems, infrastructure stress related to language differences, state income tax, ethnic differences, employment rate and stability of industrial - business base, housing and utility costs, use of land, presence of rural and urban areas, availability of natural resources.

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D_V Criterion: Older Population [1] (≥ 55 Years old)

% > 55 yrs old	Score
≤ State average	1
State average -1.33 x State avg	2
1.34 x State avg-1.66 x State avg	3
1.67 x State avg-2 x State avg	4
> 2 x the State avg	5

[1] Vulnerable older population age is assumed to be ≥ 55 y/o.

Databases:

Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

U.S. EPA. 1995. Computer Assisted Environmental Justice Index Methodology. Office of Planning and Analysis, Enforcement Division, Region 6 EPA, Dallas, TX.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Age 55 representing "older" individuals is partly based upon organ reserve, decreases in mental and physical abilities, cumulative health risk considerations (i.e., consequences of smoking, diet, life style, occupational exposures, loss of homeostatis, decreased immune system function, neurological disease, loss of cognitive functions, and other factors).
2. Demographic data will be 2000 SF3 Census coverage, changing to year 2000 data the summer of 2001.
3. The "Age" analysis is a comparison to the state average and can be calculated for many different areas (block groups, tracts, counties, of radii around a point location). Region 6 EPA enforcement, education and health risk targeting demographic evaluations (i.e., age, income, ethnicity, education) are often for 0.56 and 4 mile radii.
4. Older individuals have an increased susceptibility to environmental health risks. It is important to know where high numbers of older populations may be in Region 6 EPA and to correlate this information with chemical release data and socio-economic factors (i.e., education, poverty, language, ethnicity).
5. Older individuals are susceptible to all environmental pollutants and to specific chemicals or conditions (i.e., carbon monoxide and cardio-respiratory disease, heavy metal poisoning and decreased kidney and liver function, solvent exposure and liver disease).
6. It is assumed that there are different social-economic factors specific to each Region 6 state which justifies using state averages for comparisons. Factors include: availability of insurance and health care benefits for residents, education opportunities, public transportation systems, infrastructure stress related to language differences, state income tax, ethnic differences, employment rate and stability of industrial - business base, housing and utility costs, use of land, presence of rural and urban areas, availability of natural resources.

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Contractor Support:

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D_V Criterion: Pregnancy [1] (population < 1 Years old)

% < 1 yr old	Score
≤ State average	1
State average-1.33 x State avg	2
1.34 x State avg-1.66 x State avg	3
1.67 x State avg-2 x State avg	4
> 2 x State avg	5

[1] Pregnancy in the population is measured by the number of children less than 1 year of age.

Databases:

Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

Klaassen, Curtis D., editor. 1998. *Casarett and Doull's Toxicology*, 5th edition. USA, McGraw-Hill.

Vaughan, V., editor. 1975. *Nelson Textbook of Pediatrics*, 10th edition. W.B. Saunders Company, Philadelphia, PA.

Goldman, Lynn R. and Sudha Koduru. June 2000. "Chemicals in the Environment and Developmental Toxicity to Children: A Public Health and Policy Perspective" in Environmental Health Perspectives, Vol. 108, Supplement 3. [incomplete citation]

Definitions, Assumptions, Limitations, Uncertainties:

1. The definition of "pregnancy" for this criteria is children less than 1 year of age. The assumption being that a pregnancy existed near this time period.
2. Demographic data will be 2000 SF3 Census coverage, changing to year 2000 data the summer of 2001.
3. The "Pregnancy" analysis is a comparison to the state average and can be calculated for many different areas (block groups, tracts, counties, of radii around a point location). Region 6 EPA enforcement, education and health risk targeting demographic evaluations (i.e., age, income, ethnicity, education) are often for 0.56 and 4 mile radii.
4. Pregnant women and their fetuses are subject to increased risks from environmental pollution and conditions.
5. The blood - placental barrier between the mother and fetus is not adequate to prevent pollutants entering the maternal blood from crossing to the fetal blood (Casarett and Doull's, 5th edition). Therefore the mother and fetus are at risk.
6. It is important to know where high number of children populations may be in Region 6 EPA and to correlate this information with chemical release data and socio-economic factors (i.e., language, education, poverty, ethnicity).
7. It is assumed that there are different social-economic factors specific to each Region 6 state which justifies using state averages for comparisons. Factors include: availability of insurance and health care benefits for residents, education opportunities, public

transportation systems, infrastructure stress related to language differences, state income tax, ethnic differences, employment rate and stability of industrial - business base, housing and utility costs, use of land, presence of rural and urban areas, availability of natural resources.

EPA Contacts:
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D_V Criterion: Population Change

% Population Change	Score
% change is a negative number	1
0-5	2
6-10	3
11-15	4
> 15	5

Databases:

Census 2000 Redistricting Data (Public Law 94-171) Summary File – (AR, LA, NM, OK, TX) [machine-readable data files] / prepared by the U.S. Census Bureau, 2001.

Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Population change can be numerically negative or positive. It is assumed that a positive change can result in added stress to the natural environment and possible increase in air, land, and water pollution.
2. Increase in population can lead to stimulation of economic growth resulting in financial and health benefits to the population. These possible benefits are not captured in the "Population Change" criteria.
3. The "Population Change" criteria can be calculated for the city, county, or state level only between 1980-1990 or 1980-2000. Change between 1990 and 2000 can be done at any level (e.g., census blocks, block groups, tracts, counties, etc).
4. Region 6 EPA enforcement, education and health risk targeting demographic evaluations (i.e., age, income, ethnicity, education) are often for 0.56 and 4 mile radii.
5. It is assumed that increased population can cause the increase demand for land, increased vehicle traffic, more construction sites, housing units, landscape and water alterations, areas for landfills, and water treatment facilities. The result can be wildlife habitat destruction, urban runoff concerns, and air pollution.

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D_V Criterion: Population Density (persons per sq.mi.)

Population Density (persons/mi^2)	Score
0	1
1-200	2
201-1,000	3
1,001-5,000	4
> 5,000	5

Databases:

Census 2000 Redistricting Data (Public Law 94-171) Summary File – (AR, LA, NM, OK, TX) [machine-readable data files] / prepared by the U.S. Census Bureau, 2001.

Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

U.S. EPA. 1995. Computer Assisted Environmental Justice Index Methodology. Office of Planning and Analysis, Enforcement Division, Region 6 EPA, Dallas, TX.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Demographic data will be 200 SF3 Census coverage or PL-94-171. Data will change to year 2000 data the summer of 2001.
2. Population density is a key component of the Environmental Justice (EJ) and the Health Risk Index (HRI) methodologies. In those evaluations the ranking scale is 0 to 4. For other evaluations the scale is 1 - 5. The scales can be changed depending on the analysis focus (the EJ and HRI are exclusively human health based).
3. It is assumed that total population risk increases with the greater number of individuals impacted.
4. It is assumed that the more densely populated areas of Region 6 carry more environmental impacts. Increased population can cause the increase demand for land, increased vehicle traffic, more construction sites, housing units, landscape and water alterations, areas for landfills, and water treatment facilities. The result can be wildlife habitat destruction, urban runoff concerns, and air pollution.
5. Many different areas can be evaluated for population density (census blocks, block groups, tracts, counties, of radii around a point location). Region 6 EPA enforcement, education and health risk targeting demographic evaluations (i.e., age, income, ethnicity, education) are often for 0.56 and 4 mile radii.

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D_V Criterion: Total Population [1]

Total Population	Score
0	1
1-200	2
201-1,000	3
1,001-5,000	4
> 5,000	5

[1] The population of an area is dependent upon the defined borders of that area (polygon).

Databases:

Census 2000 Redistricting Data (Public Law 94-171) Summary File – (AR, LA, NM, OK, TX) [machine-readable data files] / prepared by the U.S. Census Bureau, 2001.

Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

U.S. EPA. 1995. Computer Assisted Environmental Justice Index Methodology. Office of Planning and Analysis, Enforcement Division, Region 6 EPA, Dallas, TX.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Demographic data will be 2000 SF3 Census coverage or PL-94-171. Data will change to year 2000 data the summer of 2001.
2. Total Population and Population Density criteria are key components of the Environmental Justice (EJ) and the Health Risk Index (HRI) methodologies.
3. In the EJ and HRI evaluations the ranking scale is 0 to 4. For other evaluations the scale is 1 - 5. The scales can be changed depending on the analysis focus (the EJ and HRI are exclusively human health based).
4. It is assumed that total population risk increases with the greater number of individuals impacted.
5. It is assumed that the more highly populated areas of Region 6 carry more environmental impacts. Increased population can cause the increase demand for land, increased vehicle traffic, more construction sites, housing units, landscape and water alterations, areas for landfills, and water treatment facilities. The result can be wildlife habitat destruction, urban runoff concerns, and air pollution.
6. Many different areas can be evaluated for total population (census blocks, block groups, tracts, counties, of radii around a point location). Region 6 EPA enforcement, education and health risk targeting demographic evaluations (i.e., age, income, ethnicity, education) are often for 0.56 and 4 mile radii.

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D_V Criterion: Houses Lacking Complete Plumbing [1]

% Housing Units Lacking Complete Plumbing	Score
≤ 1.5	1
1.6- 3	2
3.1-6	3
6.1-7.5	4
> 7.5	5

[1] Drinking water supply and sewage system.

Databases:

Census 2000
Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Data is gathered at the block group level and must be modified to apply to watershed or other non political boundary.
2. Assessments by watershed or other geographic area use the "area weighting" technique for block groups bisected by geographic boundaries.
3. It is assumed that plumbing refers to public or private furnished drinking water and sewage removal systems.
4. It is assumed that the lack of complete plumbing systems would make these households more likely to use individually dug wells or surface water, and to use septic tanks or cesspools.
5. It is assumed that systems used by homes without complete plumbing are monitored for quality less often, receive anti-microbial treatment sporadically or not at all, will be seasonal in quantity and quality, require secondary transport containers, and water may be stored without treatment. Therefore the water is more likely to become contaminated.
6. This criteria can be calculated for several different areas (block groups, tracts, counties, of radii around a point location). Region 6 EPA enforcement, education and health risk targeting demographic evaluations (i.e., age, income, ethnicity, education) are often for 0.56 and 4 mile radii.

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D_V Criterion: Telephone Communications [1]

% Housing Units Lacking Telephones	Score
≤ 12	1
13 -15	2
16-20	3
21-25	4
> 25	5

[1]Telephone communications are important for distribution of environmental information to residents and from communities.

Databases:
Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:
U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:
1. Data is gathered at the block group level and must be modified to apply to watershed or other non political boundary.
2. Assessments by watershed or other geographic area use the "area weighting" technique for block groups bisected by geographic boundaries.
3. It is assumed that telephones are essential for community organization, government outreach to communities, resident's contact with local, state, and federal environmental agencies, and for notification to residents concerning industry accidental releases, and natural disasters.
4. This criteria can be calculated for several different areas (block groups, tracts, counties, of radii around a point location).
5. Does not include cellular phones.

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D_V Criterion: Ability to Speak English

% population not able to speak English well	Score
≤ 5.5	1
5.6-10.5	2
10.6-16	3
17-25	4
> 25 %	5

Databases:
Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:
U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:
1. Persons age 18 to 64 who speak another language and speak English "no well" or "not at all".
2. Data is gathered at the block group level and must be modified to apply to watershed or other non political boundary.
3. Assessments by watershed or other geographic area use the "area weighting" technique for block groups bisected by geographic boundaries.
4. It is assumed that not speaking English is a barrier to taking full advantage of written and verbal communications, environmental, educational, and health benefits within the infrastructure of municipal government.
5. It is assumed that not being able to speak English puts these individuals at an increased environmental, economic, and health risk.
6. This criteria can be calculated for several different areas (block groups, tracts, counties, of radii around a point location).

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D_V Criterion: Linguistic Isolation

% Households Linguistically Isolated[1]	Score
≤ 8%	1
9-15	2
16-22	3
23-35	4
> 35	5

[1] Households where no one speaks English

Databases:
Census 2000 Summary
File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:
U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:
1. "Linguistically Isolated" refers to household where no one speaks English

2. Data is gathered at the block group level and must be modified to apply to watershed or other non political boundary.

3. Assessments by watershed or other geographic area use the "area weighting" technique for block groups bisected by geographic boundaries.

4. It is assumed that not speaking English is an impediment to taking full advantage of written and verbal communications, environmental, educational, and health benefits within the infrastructure of municipal services.

5. It is assumed that not being able to speak English puts these individuals at an increased environmental, economic, and health risk.

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D_V Criterion: Foreign Born [1]

% population that is foreign born	Score
≤ 6	1
7-10	2
11-20	3
21-30	4
> 30	5

[1]Excluding those from Puerto Rico or the Virgin Islands. Data is captured at the census block group level.

Databases:

Census 2000 Summary
File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:

U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. "Foreign Born" are individuals who are not born in the United States, Puerto Rico, U.S. Virgin Islands, or other U.S. territories. Individuals born abroad of U.S. parents are not counted as Foreign Born.
2. Data is gathered at the block group level and must be modified to apply to watershed or other boundary.
3. Assessments by watershed or other geographic areause the "area weighting" technique for block groups bisected by geographic boundaries.
4. It is assumed that not being U.S. born could be an impediment to taking full advantage of written and verbal communications, participation in the political process, environmental, educational, or health benefits within the infrastructure of municipal services due to language, cultural differences, or other reasons.

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D_I Criterion: **Cultural Resources**

Section 106 Compliance[1]	Score
Yes	1
No	5

[1]Section 106 of National Historic Preservation Act

Databases:
Information supplied by facility.

References:
National Historic Preservation Act of 1966, as amended, 16 U. S. C. Section 470-470w-6.
U. S. EPA. 1970. Implementation Regulations for the National Environmental Policy Act, Washington, DC. [incomplete citation]

Definitions, Assumptions, Limitations, Uncertainties:
1. Federal non-compliance constitutes potential significant adverse impacts on cultural resources or historic properties.

2. Section 106 decision is based on consultation with and the advice of the State Historical Preservation Office.

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Toxicity

D_I Criterion: Toxicity Weighted TRI Water Releases

HRI[1] Score for TRI[2] Water Releases	Score
≤ 1,000,000	1
1,000,001-2,500,000	2
2,500,001-5,000,000	3
5,000,001-10,000,000	4
> 10,000,000	5

[1] HRI - Region 6 Health Risk Index methodology
[2] TRI - 2000 Toxic Release Inventory data

Databases:

U. S. Environmental Protection Agency. 2000. Toxic Release Inventory. TRI Data: SARA Community Right-to-know. Washington, D.C. [updated annually]

U.S. EPA, 2002. Emergency Planning and Community Right-to-Know Act (EPCRA), Section 313, Toxic Release Inventory (TRI) 2000 chemical release data. TRIS website download. Office of Pollution Prevention and Toxics, Washington, D.C. 20460

References:

U.S. EPA, 1998 Health Risk Index (HRI) GIS screening methodology. Office of Planning and Coordination, Compliance Assurance & Enforcement Division, Region 6 EPA, Dallas, TX 75202. [unpublished]

U.S. EPA, 1997. Toxic Release Inventory Relative Risk - Based Environmental Indicators Methodology, Office of Pollution Prevention and Toxics, Washington, D.C. 20460. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Exposure to surrounding populations is assumed to occur from water pollutants released by regulated industries.
2. TRI chemical releases are annual estimates. The releases could be over a very short time or over a several month period. It is assumed that these releases can cause human health and ecological impacts.
3. TRI reported pounds of chemical released to water are multiplied by an average of the oral toxicity factor (scaled from 1 to 5) and a bioaccumulation factor (BCF) (scaled 1 to 5). Algorithm: # chemical x (average of BCF & Oral Tox value). Each chemical's toxicity numbers are then summed. This analysis is performed for each TRI facility in a targeted geographic area. The toxicity numbers of all facilities are summed resulting in a final number which is scaled from 1 to 5.

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D_I Criterion: **Toxicity Weighted TRI AIR Releases**

HRI[1] Score for TRI[2] Air Releases	Score
≤ 1,000,000	1
1,000,001-2,500,000	2
2,500,001-5,000,000	3
5,000,001-10,000,000	4
> 10,000,000	5

[1] HRI - Health Risk Index methodology, unitless number (pounds X toxicity factors).
[2] TRI -1998 Toxic Release Inventory data

Databases:

U. S. Environmental Protection Agency. 2000. Toxic Release Inventory. TRI Data: SARA Community Right-to-know. Washington, D.C. [updated annually]

References:

U.S. EPA, 1998. Health Risk Index (HRI) GIS screening methodology. Office of Planning and Coordination, Compliance Assurance & Enforcement Division, Region 6 EPA, Dallas, TX. 75202. [unpublished]

U.S. EPA, 1997. Toxic Release Inventory Relative Risk - Based Environmental Indicators Methodology, Office of Pollution Prevention and Toxics, Washington, D.C. 20460. [unpublished]

U.S. EPA, 2002. Emergency Planning and Community Right-to-Know Act (EPCRA), Section 313, Toxic Release Inventory (TRI) 2000 chemical release data. TRIS web site download. Office of Pollution Prevention and Toxics, Washington, D.C. 20460

Definitions, Assumptions, Limitations, Uncertainties:

1. Exposure to surrounding populations is assumed to occur from air pollutants released by regulated industries.
2. TRI chemical releases are annual estimates. The releases could be over a very short time or over a several month period. It is assumed that these releases can cause human health and ecological impacts.
3. TRI reported pounds of chemical released to air are multiplied by an inhalation toxicity factor (scaled from 1 to 5). Algorithm: # chemical x Tox value. Each chemical's toxicity numbers are then summed. This analysis is performed for each TRI facility in a targeted geographical area. Toxicity numbers of all facilities are summed resulting in a final number which is scaled from 1 to 5.

EPA Contacts:

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D_I Criterion: Toxicity Weighted RCRA-BRS[2] Data

RCRA[1] facility waste (tons)	Score
≤ 1 or nonreported	1
2-100	2
101-1,000	3
1,001-100,000	4
> 100,000	5

[1]RCRA (Resource Conservation and Recovery Act)
[2] BRS (Biennial Report System), modified tons

Databases:

U.S. EPA, 2000.
Biennial Report System (BRS). State data stored in EPA's BRS system.
Washington, D.C. 20460

References:

U.S. EPA, 1998. Health Risk Index (HRI) GIS screening methodology. Office of Planning and Coordination, Compliance Assurance & Enforcement Division, Region 6 EPA, Dallas, TX. 75202. [unpublished]

U.S. EPA, 1997. Toxic Release Inventory Relative Risk - Based Environmental Indicators Methodology, Office of Pollution Prevention and Toxics, Washington, D.C. 20460 [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Hazardous waste chemicals being used, transported, or stored on an industrial site can be released as fugitive emission, through spills, or cause damage to surrounding areas and residents through explosions or fire.
2. The more reported BRS RCRA waste on a site, the more potential for environmental harm.
3. RCRA BRS data is a reporting system for RCRA waste either generated or received. Data collected by states and then entered into EPA's BRS.
4. RCRA BRS chemicals reported pounds (modified tons) are compared to TRI chemicals. TRI chemicals were matched with RCRA chemicals or surrogates were found for each RCRA chemical. HRI chemical toxicity factors were matched to each RCRA chemical or TRI surrogate representing a RCRA chemical. There is significant uncertainty in the use of surrogates.
5. RCRA - BRS chemical data are by biennial reporting. Associated chemical releases to the environment could be over a very short time or over a several month period. It is assumed that these releases can cause human health and ecological impacts.

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D_V, D_I Criterion: Other Industries, Pollution Sources, or Protected Lands

Number within a 2 mi buffer	Score
0 industries or land areas	1
1 industries or land areas	2
2 industries or land areas	3
3 industries or land areas	4
$\geq$ 4 industries or land areas	5

Databases:

U.S. EPA, 2002. Envirofacts Database. www.epa.gov/enviro
U.S. EPA, 2002. Toxic Release Inventory.
U.S. EPA, 2002. National Priority List sites.
TCEQ, 1996. Permitted Industrial & Hazardous Waste Sites
TCEQ, 1996. Municipal Solid Waste Landfills
TCEQ, 2000. Radioactive Waste Sites
TCEQ, 2002. Superfund Sites

Definitions, Assumptions, Limitations, Uncertainties:

1. Other industries or pollution sources are defined as solid waste landfills, water supply intake points, RCRA Sites, Indian Reservations, Superfund (NPL) sites, Federal Facilities, radioactive sites, and Toxic Release Inventory (TRI) sites.
2. Project areas (using the appropriate geographic scale) can be negatively effected or become more environmentally vulnerable by the cumulative impacts or proximity of manufacturing industries, agriculture, defense facilities, or environmentally important land areas.
3. Subject areas within two miles of existing facilities are factors in the assessment of cumulative environmental impacts.
4. All environmentally important locations or sources of stress are not accounted for.
5. This criterion may be calculated for the most appropriate geographic area and scale (e.g., watershed subunits, transportation corridors, or project areas).
6. The area of analysis may be broken into 1 km grid cells for GISST criteria computation.

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CAFO

D_I Criterion: Livestock Population Density (Animal Units/CAFO Total Acres)

Livestock Pop. Density (LPD)[1]	Score
≤ 10	1
11-20	2
21-25	3
26-30	4
> 30	5

[1]Animal Units/CAFO Acres (LPD of 10 is 25 swine per acre)

Databases:
Information from facility.

References:
Agri-Waste Technology, Inc., HUC Cumulative Risk Index Analysis Swine Producer Group, October 26, 1996, Raleigh, NC. [unpublished]

U.S. EPA. 1995. *Guide Manual on NPDES Regulations for Concentrated Animal Feeding Operations.* EPA 833-B-95-001. U. S. Environmental Protection Agency, Office of Water (4203). Washington, D.C.

Definitions, Assumptions, Limitations, Uncertainties:
1. 0.4 animal unit is assigned to each hog weighing more than 55 lbs. Two thousand, five hundred swine over 55 lbs. each equals 1000 animal units. For piglets, 0.2 is considered an equivalent animal unit.

2. The fewer the number of animal units per facility acre the less potential for impacts.

3. CAFO acres is the total acreage and includes buildings, treatment facilities, and application areas.

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D_I Criterion: Lagoon Loading Rate

% Lagoon Loading Rate (LLR)	Score
≤ 100%	1
101%-110%	2
111%-120%	3
121%-130%	4
> 130%	5

Databases:
Information from facility.

References:
Agri-Waste Technology, Inc., HUC Cumulative Risk Index Analysis Swine Producer Group, October 26, 1996, Raleigh, NC. [unpublished]

U.S. Department of Agriculture, Natural Resource Conservation Service. Agricultural Waste Management System Component Design, Figure 10-22 Anaerobic Lagoon Loading Rate. [incomplete citation]

Watson, H. 1991. *Lagoons for Animal Waste Disposal*. Alabama Cooperative Extension Service. Auburn University, AL.

Definitions, Assumptions, Limitations, Uncertainties:
1. NRCS has developed a map that suggests the appropriate lagoon design volume (pounds of volatile solids per 1000 cubic feet of lagoon per day). This design is exclusive of sludge storage and waste storage.

2. Permitted facilities are not expected to exceed the 100% Lagoon Loading Rate whereas non-permitted facilities may exceed 100%.

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D_I Criterion: Lagoon Treatment System Liner

% Hydraulic Conductivity Rate[1]	Score
≤ 100%	1
101%-105%	2
106%-110%	3
111%-115%	4
> 115%	5

[1]EPA NPDES General Permit for CAFOs (1993) defines the maximum acceptable hydraulic conductivity as 1 X 10^{-7} cm/sec.

Databases:
Information from facility.

References:
Agri-Waste Technology, Inc., HUC Cumulative Risk Index Analysis Swine Producer Group, October 26, 1996, Raleigh, NC. [unpublished]

U.S. Department of Agriculture, Soil Conservation Service. Agricultural Waste Management System Component Design, Figure 10-22 Anaerobic Lagoon Loading Rate. [incomplete citation]

U.S. EPA. 1993. 40 CFR 122. *NPDES General Permit for Discharges from Concentrated Animal Feeding Operations*. U. S. Environmental Protection Agency, Washington, D.C.

Watson, H. 1991. *Lagoons for Animal Waste Disposal.* Alabama Cooperative Extension Service. Auburn University, AL.

Definitions, Assumptions, Limitations, Uncertainties:
1. The design, construction and operation of lagoons determine their effectiveness.

2. Permitted facilities are not expected to exceed the 100% Hydraulic Conductivity Rate whereas non-permitted facilities may exceed 100%.

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D_I Criterion: Land Application Technology

Land Application Systems[1]	Score
Innovative Technology	1
Desirable	2
Conventional	3
Poor	4
None	5

[1] Technology systems described below.

Databases:
Information from facility.

References:
Dendy, D. and M. Ladd 1996. Comments on Draft Cumulative Risk Analysis, ACCORD Agriculture, Inc., Farnsworth, TX.[unpublished]

U.S. EPA. 1996. *Swine CAFO Odors: Guidance for Environmental Impact Assessment.* U. S. Environmental Protection Agency Region 6, Lee Wilson and Associates, Santa Fe, NM. EPA Contract No. 68-03-0142. Dallas, TX.

Miner, J. R. 1995. *An Executive Summary: A Review of the Literature on the Nature and Control of Odors from Pork Production Facilities*. Bioresource Engineering Department, Oregon State University, Corvallis, OR.

Definitions, Assumptions, Limitations, Uncertainties:
1. Innovative technology includes subsurface injection and tillage of waste within three hours of application.
2. Desirable technology includes low pressure sprinkler systems (15-20 psi), minimizing land application impacts near residents, low trajectory spray, avoiding extra-fine spray.
3. Conventional technology includes medium pressure (30-70 psi) sprinkler systems, avoids weekends and holiday application, and uses vegetative screens.
4. Poor technology includes high pressure sprinkler systems (>80 psi), high trajectory spray, does not avoid application on weekends or holidays, and does not use vegetative screens.
5. Subsurface injection and tillage technology is assumed to avoid high water tables and highly permeable soils.
6. Injection of slurry can reduce the odor by 80% and ammonia emissions by 95%.
7. Above ground application of wastes should be tilled into the soil as soon as possible to reduce the rate of odor emissions. Plowing immediately after application reduces the rate of odor emission during the first hour by 85%.
8. None equals no technology used or reported.

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D_I Criterion: Nitrogen Budget

Crop Nitrogen Budget (CNB)[1]	Score
≤ 100%	1
99%-110%	2
111%-120%	3
121%-130%	4
> 130%	5

[1] The Crop Nitrogen Budget percent is the ratio of the sum of the annual plant available nitrogen produced and the commercial nitrogen fertilizer to be used divided by the crop nitrogen that can be utilized each year times 100.

Databases:
Information from facility.

References:
Agri-Waste Technology, Inc., HUC Cumulative Risk Index Analysis Swine Producer Group, October 26, 1996, Raleigh, NC. [unpublished]

Natural Resource Conservation Service. Estimate of land Area Needed for Waste Application and Value of Nutrients Applied. [incomplete citation]

Natural Resources Conservation Service. 1992. *Agricultural Waste Management Field Handbook*. Natural Resources Conservation Service, USDA, Washington, D.C.

U.S. EPA. 1993. 40 CFR 122. *NPDES General Permit for Discharges from Concentrated Animal Feeding Operations*. U. S. Environmental Protection Agency, Washington, D.C.

Definitions, Assumptions, Limitations, Uncertainties:
1. The Crop Nitrogen Budget percent is the ratio of the sum of the annual plant available nitrogen produced and the commercial nitrogen fertilizer to be used divided by the crop nitrogen that can be utilized each year times 100.
2. Annual plant available nitrogen is the amount of nitrogen available to the plant from the applied waste effluent.
3. Land application crops typically require commercial fertilizers in addition to nutrients from waste effluent.
4. Application rates of waste effluent might be limited by other parameters (salt loadings, phosphorus loadings, hydraulic loadings).

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D_I Criterion: Phosphorus Budget

Crop Phosphorus Budget (CPB)[1]	Score
≤ 100%	1
99%-110%	2
111%-120%	3
121%-130%	4
> 130%	5

[1] The Crop Phosphorus Budget percent is the ratio of the sum of the annual plant available phosphorus produced and the commercial phosphorus fertilizer to be used divided by the crop phosphorus that can be utilized each year times 100.

Databases:
Information from facility.

References:
Natural Resource Conservation Service. Estimate of Land Area Needed for Waste Application and Value of Nutrients Applied. [incomplete citation]

Natural Resources Conservation Service. 1992. *Agricultural Waste Management Field Handbook*. Natural Resources Conservation Service, USDA, Washington, D.C.

U.S. EPA. 1993. 40 CFR 122. *NPDES General Permit for Discharges from Concentrated Animal Feeding Operations*. U. S. Environmental Protection Agency, Washington, D.C.

Definitions, Assumptions, Limitations, Uncertainties:
1. Annual plant available phosphorus is the amount of phosphorus available to the plant from the applied waste effluent.
2. Land application crops typically require commercial fertilizers in addition to nutrients from waste effluent.
3. Application rates of waste effluent might be limited by other parameters (e.g., salt loadings, nitrogen loadings, hydraulic loadings).
4. Buildup of phosphorus in the soil over time may have negative environmental impacts (e.g., runoff of accumulated phosphorus).

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D_I Criterion: Lagoon Storage Capacity [1]

Retention time (days)	Score
> 90	1
89-60	2
59-30	3
29-15	4
< 15	5

[1] Lagoon storage above the 25 year -24 hour storm event capacity.

Databases:
Information from facility.

References:
Agri-Waste Technology, Inc., HUC Cumulative Risk Index Analysis Swine Producer Group, October 26, 1996, Raleigh, NC. [unpublished]

Natural Resources Conservation Service. 1992. *Agricultural Waste Management Field Handbook*. Natural Resources Conservation Service, USDA, Washington, D.C.

U.S. EPA. 1993. 40 CFR 122. *NPDES General Permit for Discharges from Concentrated Animal Feeding Operations*. U. S. Environmental Protection Agency, Washington, D.C.

Definitions, Assumptions, Limitations, Uncertainties:
1. Storage volume above the 25 year-24 hour storm can minimize potential environmental impacts.

2. Even though the expired CAFO permit required a lagoon capacity of at least 21 days, the 15 day capacity or less (score of 5 above) reflects CAFOs that may fall below the permit threshold and do not meet permit conditions.

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D_I Criterion: **Well Head Protection**

Well distance from source[1]	Score
≥ 500 feet	1
400- 499 feet	2
300-399 feet	3
200-299 feet	4
< 200 feet	5

[1] Source of potential ground water contamination are water retention facilities, confinement buildings, and application sites.

Databases:
Information from facility.

References:
Dendy, D. and M. Ladd 1996. Comments on Draft Cumulative Risk Analysis, ACCORD Agriculture, Inc., Farnsworth, TX. [unpublished]

Goan, C. 1992. *Well Water Protection on Poultry Farms*. University of Tennessee Agricultural Extension Service.

Definitions, Assumptions, Limitations, Uncertainties:
1. Well location is a potential factor contributing to possible ground water contamination. The closer the well is to potential sources of contamination the greater the environmental concern.

2. Well and shaft (outside of well pipe) are potential conduits for ground water contamination.

3. Well head protection criteria does not consider construction and design parameters.

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D_I Criterion: Employment in CAFO Industry

Job Units[1] at CAFO Site	Score
≥ 4	1
3	2
2	3
1	4
0	5

[1] A job unit is equal to the state average income.

Databases:
Information from facility.

References:
Canter, L. W. 1977. *Environmental Impact Assessment.* McGraw-Hill Book Co. New York, NY.

Dendy, D. and M. Ladd 1996. Comments on Draft Cumulative Risk Analysis, ACCORD Agriculture, Inc., Farnsworth, TX.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:

1. Job opportunities have both positive and negative economic effects on the local community.

2. Agricultural jobs lost may not equal the job (units) created.

3. Construction jobs, are not included since they are primarily short term, may include mostly migrant workers, and contribute little to the local economy.

4. Only a small percentage of construction materials (items that cannot be economically trucked in) and supplies are purchased locally and benefit the local economy.

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D_I Criterion: Odor (from CAFOs)

Total Number of Animals	Score
≤ 5 x threshold[1]	1
6- 10 x threshold	2
11-15 x threshold	3
16-20 x threshold	4
> 20 x threshold	5

[1] Threshold for swine = 750 animal units

Databases:
Information from facility.

References:
Miner, J. R. and C. L. Barth. 1988. *Controlling Odors from Swine Buildings.* Purdue University Cooperative Extension Service. West Lafayette, IN.

U.S. EPA. 1996. *Swine CAFO Odors: Guidance for Environmental Impact Assessment.* U. S. Environmental Protection Agency Region 6, Lee Wilson and Associates, Santa Fe, NM. EPA Contract No. 68-03-0142. Dallas, TX.

Definitions, Assumptions, Limitations, Uncertainties:
1. An individual's perception of odor is primarily a subjective response based on attitudes and previous experience.
2. Odor may be associated with water pollution, flies, noise or other issues.
3. Odor is an indicator of ineffective air pollution control.
4. Residents may be reasonably close to CAFO facilities.
5. Animal units does not equal number of animals (e.g., 2500 swine over 55 lbs each equals 1000 animal units).
6. Swine odor is generally considered to be more offensive than cattle or chicken odor.
7. "Odor" includes chemicals such as ammonia, methane gas, and hydrogen sulfide that may affect the health of nearby residents.
8. Animal type and management controls could also determine the intensity of odor.

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D_I Criterion: Transportation near CAFOs

Number of Trucks/week	Score
≤ 7	1
7-14	2
15-21	3
22-28	4
≥ 28	5

Databases:
Information from facility.

References:
Canter, L. W. 1977. *Environmental Impact Assessment.* McGraw-Hill Book Co. New York, NY.

Dendy, D. and M. Ladd 1996. Comments on Draft Cumulative Risk Analysis, ACCORD Agriculture, Inc., Farnsworth, TX. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:
1. The less truck traffic in the area the lower the potential for negative impacts.

2. Trucks are defined as the vehicles used in feeding and transporting (live) animals.

3. Potential negative impacts include traffic accidents, dust, noise and odor.

4. Road surface conditions are considered to be unimproved, county roads.

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D_I Criterion: Density of CAFOs[1]

Number within 4 mi	Score
≤ 2	1
3	2
4	3
5	4
> 5	5

Databases:

Oklahoma DOA. 1996. CAFO Database. Oklahoma Department of Agriculture, Oklahoma City, OK.

U.S. EPA. 1996. CAFO Location Data Set. U. S. Environmental Protection Agency Region 6 GIS Data Library. Dallas, TX.

Definitions, Assumptions, Limitations, Uncertainties:

1. The more CAFOs in a watershed subunit, the greater the potential for negative impacts.
2. Four mile radius is used to be comparable with other Region 6 risk index analyses (e.g. Human Health Risk Index, Environmental Justice Index).
3. The majority of CAFOs are assumed to be in the same watershed or geographic area, but there is the possibility that CAFOs can be in different HUCs or geographic areas.
4. The number of CAFOs in a four mile radius was chosen by considering the size of the facilities (0.25-1 mi. sq.), desirable distance between the projects (2 miles), typical size of the 11 digit HUC, and the impacts of the CAFOs (runoff and odor) on the watershed or other geographic area.
5. EPA data used for states other than Oklahoma.
6. The density criterion differs from the proximity criterion in that proximity measures how close CAFOs are to each other (must be a minimum buffer area), this is not necessarily measured in the density criterion. For example, there may be 10 CAFOs in a certain area (density), but they may be more clumped (greater proximity) or dispersed (lesser proximity).

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D_I Criterion: Proximity of CAFOs [1]

Number Within 2mi	Score
0	1
$\geq$ 1	5

[1] Includes EPA and state CAFO data

Databases:

Oklahoma DOA. 1996. CAFO Database. Oklahoma Department of Agriculture, Oklahoma City, OK.

U.S. EPA. 1996. CAFO Location Data Set. U. S. Environmental Protection Agency Region 6 GIS Data Library. Dallas, TX.

References:

U.S. EPA. 1996. *Swine CAFO Odors: Guidance for Environmental Impact Assessment.* U. S. Environmental Protection Agency Region 6, Lee Wilson and Associates, Santa Fe, NM. EPA Contract No. 68-03-0142. Dallas, TX.

Definitions, Assumptions, Limitations, Uncertainties:

1. The closer the proximity of CAFOs, the greater the potential for negative environmental impact (e.g., odor, noise) to the watershed subunit or other geographic area.

2. The majority of CAFOs are assumed to be in the same watershed or defined geographic area, but there is the possibility that CAFOs can be in different HUCs or geographic areas.

3. EPA data used for states other than Oklahoma.

4. The density criterion differs from the proximity criterion in that proximity measures how close CAFOs are to each other (must be a minimum buffer area), this is not necessarily measured in the density criterion. For example, there may be 10 CAFOs in a certain area (density), but they may be more clumped (greater proximity) or dispersed (lesser proximity).

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